

## CHAPTER 8

### LIFTING AND MOVING DEVICES SUCH AS CRANES AND ELEVATORS

---

#### 8-1. Description of lifting and moving devices

There are many types, variations, and capacities of lifting and moving devices to move objects and personnel. The devices addressed in this manual are primarily for moving objects, however freight elevators as well as personnel elevators can be used for moving personnel and objects. Included in this manual is a description of lifting and moving devices commonly encountered.

*a. Lifting devices.* A description of typical cranes and other common lifting devices follows.

(1) Bridge cranes are versatile and used in many applications. They consist of columns, rails, a bridge, trolley, one or more hoists, and for control a pendant, cab, and radio operator.

(2) Jib cranes have a limited access area but are less expensive than other cranes. They consist of a column, swinging jib, trolley, hoist, and pendant.

(3) Gantry cranes are like mobile bridge cranes. They consist of a mobile gantry, trolley, hoist, and pendant.

(4) Frequently used non-powered lifting devices include hydraulic jacks, chain hoists, and rigging such as chains, wire ropes, slings, chokers, hooks, and spreader bars.

*b. Elevators.* Elevators consist of hydraulic ram lifts or motor driven cable lifts, a framed elevator shaft, an elevator car/enclosure with doors, telephone or intercom, and push button controls.

*c. Lifting and moving devices.* More information on requirements for design, maintenance, and testing of lifting and moving devices is to be found in the Occupational Health and Safety Administration, Standards (OSHA), Regulations Standards 29 CFR 1910 – Subpart N Material Handling and Storage, 1910.179 Overhead and gantry cranes, and 1910.184 Slings, plus 1926 – Subpart H Material Handling, Storage, Use, and Disposal, 1926.251 Rigging equipment for material handling, as well as 1926 – Subpart N Cranes and Derricks, 1926.550 Cranes, derricks, hoists, elevators, and conveyers, and 1926.552 Material hoists, personnel hoists, and elevators, and 1926.554 Overhead hoists. Additional information is supplied by the American Society of Mechanical Engineers (ASME) A 17.1 Safety Code for Elevators and Escalators, and B30 Cranes and Hoists. Further work has been done by the Sterling Elevator Consultants, LLC, Technical Paper, Elevator Safety Presentation

#### 8-2. Operation of lifting and moving devices

Operation of the devices addressed in this manual for moving objects and personnel follow.

*a. Lifting devices, operation.* Following is a discussion of the operation of cranes and other common lifting devices typically encountered in facilities.

(1) Bridge cranes travel on rails supported by columns. End stops are provided on the rails to limit crane travel. The crane columns may be separate or integral with the building steel. Foundations must be designed for the additional load of the crane. The crane consists of the bridge which spans the distance between the rails, a trolley which traverses the bridge, and one or more hoists located on the trolley. End stops are provided on the bridge to limit travel of the trolley and limit switches are provided on the hoist to limit travel of a wire rope-mounted hook. Travel is normally controlled by a pendant with separate buttons for movement in the north, south, east, and west directions for the bridge and trolley and up and down for the hook on the hoist. If desired, motor speeds can be in steps or variably adjustable. Automatic brakes are provided on all traversing and lifting motors. In some cases the pendant is replaced with a radio controller, thereby eliminating the wire to the pendant. On larger cranes, controls can be provided in a bridge mounted operator cab. The lifting capacity of the crane must be clearly indicated and visible to the operator. Operators and personnel must not be under the lifted load at any time.

(2) A jib crane includes a counter weight foundation mounted column with a swinging jib. Stops are provided on the column to limit the swing of the jib and also on the jib to limit trolley movement. The hoist is pendant controlled and with limit switches to safely limit hook travel. The trolley and jib can also be powered if desired. The lifting capacity of the crane must be clearly indicated and visible to the operator. Operators and personnel must not be under the lifted load at any time.

(3) Gantry cranes consist of an inverted "U" shaped structure called a gantry. The structure is mobile and can straddle objects. A trolley traverses the upper cross member and supports a hoist. The gantry and trolley can be powered similar to a bridge crane. Stops and limit switches are provided as needed to limit movement of the gantry, trolley, and hoist hook. A pendant is used for control. The lifting capacity of the crane must be clearly indicated and visible to the operator. Operators and personnel must not be under the lifted load at any time.

(4) Non-powered lifting devices and rigging include hydraulic jacks, chain hoists, chains, wire ropes, slings, chokers, hooks, shackles, and spreader bars. The lifting capacity of lifting devices and rigging must be clearly labeled. Operators and personnel must not be under any lifted load at any time and must not ride on any hook or load.

*b. Elevators, operation.* Elevators are used to lift freight and personnel. Lifting is accomplished by a hydraulic ram or cable drive with interlocks to control the acceleration, speed, stop positions, elevator doors, access doors, and safety of the car. The elevator car/enclosure travels vertically in an elevator shaft with guide rails, and is provided with doors or a gate, roof hatch, and push button controls. The doors/gate must be closed for the car to move. A mechanical safety brake is provided as a redundant safety to limit the travel of the car should all other mechanical and electrical interlocks and safeties experience a problem simultaneously. The lifting capacity of the elevator must be clearly indicated and visible to an operator. The car should be well lit, and be provided with an alarm, emergency lights, and an emergency phone or intercom. Elevator entrances should be clear of tripping and slipping hazards. Elevators are the only lifting and moving devices which may be used to lift personnel.

### 8-3. Pre-functional test plan and functional performance test plan for lifting and moving devices

This manual assumes that individual components and packaged equipment have been tested by the manufacturer. As part of the commissioning effort each component should be checked for damage, deterioration, and failures by a procedure using inspections and tests as defined by the specific equipment manufacturers. Equipment manuals from manufacturers identify the minimum required receipt inspections, handling and installation procedures, drawing and wiring verification, field inspection and installation checks, verification of removal of shipping braces, inspection of installation against drawings and nameplates, inspection of components for damage and cleanliness, inspection of insulators and grounding, inspection of anchorage and alignment, adjustment checks, mechanical operation and interlock checks, lubrication application, and verification that local safety equipment is in place.

*a. Tests, lifting and moving devices.* Tests and inspections as defined by the American Society of Mechanical Engineers (ASME) and as recommended by OSHA and the insuring agency should be done by licensed and bonded crane/elevator companies. Inspection checklists are provided to the facility manager and others as requested. These tests should form the basis of acceptance as required by the commissioning plan. Some pre-functional tests may be conducted to provide general knowledge of the system. These are outlined in figure 8-1, Example of a completed DA Form 7484-R, lifting and moving devices inspection checklist and figure 8-2, Example of a completed DA Form 7485-R, elevator inspection checklist.

*b. Safety, lifting and moving devices.* Many tests involve the use of high voltages, high currents, pressurized hydraulic systems, and heavy loads. These can be dangerous to personnel and damaging to equipment. A procedure should be followed to insure adequate safety rules are instituted and practiced to prevent injury to personnel performing the tests and other personnel who might be in the local area. Personnel are permitted to ride in personnel elevators and freight elevators appropriately equipped and labeled. Personnel must not ride on any lifting hook

*c. Test equipment, lifting and moving devices.* It is important that in any test program the proper equipment is used. The equipment should be calibrated, in good condition, and used by qualified operators as required by a procedure. Any test equipment used for calibration shall have twice the accuracy of the equipment to be tested. All equipment should be operated in accordance with its instruction manual. A procedure defining installation inspection and moving and lifting equipment tests needs to be provided.

<b>LIFTING AND MOVING DEVICES INSPECTION CHECKLIST</b> For use of this form, see TM 5-697; the proponent agency is COE.					
<b>SECTION A - CUSTOMER DATA</b>					
1. PLANT East Building		2. LOCATION Washington, DC		3. JOB NUMBER EB03-104	
4. EQUIPMENT Forklift		5. SYSTEM DESIGNATION FL 02		6. DATE (YYYYMMDD) 20030120	
7. TEST EQUIPMENT Weight standard, Cable inspection gear, lift history				8. TESTED BY Roger Swanson	
<b>SECTION B - EQUIPMENT DATA</b>					
9. CRANE MANUFACTURER Grove Telescopic Boom		10. MODEL NO Y2933	11. SERIAL NO 81704	12. LOCATION Building 42	13. CAPACITY 22 Tons
14. HOIST MANUFACTURER MY-TE		15. MODEL NO 10-22	16. SERIAL NO 2375	17. LOCATION Building 42	18. CAPACITY 750 lbs
<b>SECTION C - VISUAL AND MECHANICAL INSPECTION</b>					
19. CHECK POINT		COND*	NOTES	CHECK POINT	
EXTERIOR OF EQUIPMENT		A		EQUIPMENT IDENTIFICATION	
COMPLETENESS OF ASSEMBLY		A		EQUIPMENT CONDITION	
CONTROL SYSTEM DISPLAY		A		CAPACITY IDENTIFICATION	
SAFETY INTERLOCKS		A		LABELING AND TAGGING	
ELECTRICAL/MECHANICAL INTERLOCKS		A		END AND/OR SWING STOPS IN PLACE	
INSTRUMENTS AND ALARMS		R	1	ACCESS	
PROPER GROUNDING		A		ANCHORAGE	
PROPER INSULATION		A		COMPARISON TO DRAWINGS	
CABLE CHAIN CONDITION		A		ALIGNMENT	
<b>SECTION D - CALIBRATION AND SET POINT</b>					
20.		DESCRIPTION			NOTES
LIMIT SWITCHES		Check for proper adjustment and operation			
<b>SECTION E - LIFTING AND MOVING DEVICES EQUIPMENT TESTS</b>					
21.		PASS	FAIL	COMMENTS	NOTES
LOAD TEST		X			
TEST ALL BRAKES		X			
SAFETIES TEST		X			
ALARMS		X			
CABLE/HOOK INSPECTION		X			
OPERATIONAL TEST		X			
22. NOTES					
1. Glass cracked on hydraulic pressure gauge.					

\* CONDITION: A - ACCEPTABLE; R - NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C - CORRECTED; NA - NOT APPLICABLE

Figure 8-1: Example: DA Form 7484-R

ELEVATOR INSPECTION CHECKLIST					
For use of this form, see TM 5-697; the proponent agency is COE.					
<b>SECTION A - CUSTOMER DATA</b>					
1. PLANT East Building		2. LOCATION Washington, DC		3. JOB NUMBER EB03-105	
4. EQUIPMENT		5. SYSTEM DESIGNATION Otis 23		6. DATE (YYYYMMDD) 20030121	
7. TEST EQUIPMENT Voltmeter, Pressure tester, Hand tools for visual as required by type elevator				8. TESTED BY David Ryan	
<b>SECTION B - EQUIPMENT DATA</b>					
9. ELEVATOR MANUFACTURER Otis		10. MODEL NO Hydraulic		11. SERIAL NO 1290	
14. DRIVE MANUFACTURER Otis		15. MODEL NO Otis		16. SERIAL NO 3241656	
				12. LOCATION Front entrance	
				17. LOCATION Rooftop	
				13. CAPACITY 2000 lbs	
				18. CAPACITY 4000 lbs	
<b>SECTION C - VISUAL AND MECHANICAL INSPECTION</b>					
19. CHECK POINT		COND*	NOTES	CHECK POINT	
EXTERIOR OF EQUIPMENT		A		EQUIPMENT IDENTIFICATION	
COMPLETENESS OF ASSEMBLY		A		EQUIPMENT CONDITION	
CONTROL SYSTEM DISPLAY		A		CAPACITY IDENTIFICATION	
SAFETY INTERLOCKS		A		LABELING AND TAGGING	
ELECTRICAL/MECHANICAL INTERLOCKS		A		ALARM, TELEPHONE, INTERCOM	
INSTRUMENTS AND ALARMS		A		ACCESS	
PROPER GROUNDING		A		ANCHORAGE	
PROPER INSULATION		A		COMPARISON TO DRAWINGS	
ELEVATOR DOORS		A	I	ALIGNMENT	
ENTRANCE WAY		A		HYDRAULIC LEAKS	
CABLE CHAIN CONDITION		A			
<b>SECTION D - CALIBRATION AND SET POINT</b>					
20.		DESCRIPTION			NOTES
HYDRAULIC PRESSURE		Note pressure measurements and extreme positions of operation			
DOOR POSITION		Note ease of operation and opened and closed positions of doors			
<b>SECTION E - LIFTING AND MOVING DEVICES EQUIPMENT TESTS</b>					
21.		PASS	FAIL	COMMENTS	NOTES
LOAD TEST		X		Load elevator to indicated rated load	
TEST ALL BRAKES		X		Emergency stop	
SAFETIES TEST		X			
ALARMS		X			
OPERATIONAL TEST		X			
22. NOTES					
1. Doors worked smoothly					
*CONDITION: A - ACCEPTABLE; R - NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C - CORRECTED; NA - NOT APPLICABLE					

Figure 8-2: Example: DA Form 7485-R

**8-4. Possible failures and corrective measures for lifting and moving devices**

Table 8-1 below lists general problems that may arise during the testing of equipment and systems along with possible troubleshooting techniques. For all problems, consult equipment and component manuals for troubleshooting directions. Check fuses/lights/breakers/etc., for continuity, check equipment calibration and settings, check for improperly adjusted equipment and limit/proximity switches, and look for faulty equipment and connections.

*Table 8-1, Possible failures and corrective actions for lifting and moving devices*

	Areas to Check
<b>Bridge cranes, jib cranes, gantry cranes</b>	
Hoist, trolley, bridge, gantry will not actuate/move	Check key lockout switch Check control buttons/levers/joy-stick actuation and contacts Check radio signal if applicable Check mechanical alignment of limit/proximity switches Check interlocks and safeties Check for mis-wired circuits Check control panel program Check power supply Check grounds
	Check protective device settings and operation Check for mis-wired circuits Check control panel program Check for system overload or short Check grounds
<b>Elevator</b>	
Does not move	Check door/gate interlocks Check control buttons actuation and contacts Check mechanical alignment of limit/proximity switches Check interlocks and safeties Check for miss-wired circuits Check control panel program Check power supply Check grounds
Doors do not open	Check car stop position and limit/proximity switches Check car door / access door interlock Check safeties and interlocks
Car stops above or below floor level	Check car stop position and limit/proximity switches